

Analysis of Electronic Medical Record Reception using Expanded Technology Acceptance Model

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Abstract— Information technology in the health sector has the potential to increase the quality of patient care by improving process efficiency, reducing errors and reducing costs. But this potential cannot be achieved if there is rejection from stakeholders. In this study, we examine the information technology acceptance model in the medical field. We use Moores's model that was developed from Davis's Technology Acceptance Model by adding the variables that determine the success of information technology acceptance. The variables are divided into two categories: information quality consisting of accuracy, content, timeliness, and format. The Enabling factors consisting technical support and self-efficacy. The case study was conducted among medical personnel at a Hospital in East Java. The subject of research is the use of the electronic medical record. Data were obtained through a questionnaire. Then the data is processed with Partial Least Squares algorithm using PLS software. As a result of the sixteen hypotheses proposed there are fourteen hypotheses accepted and the overall model deemed appropriate.

Keywords— *Technology Acceptance Model, Health Service, Electronic Medical Record, IT adoption.*

I. INTRODUCTION

Today, information technology (IT) has provided benefits in many areas, including health. Institutions of health care providers such as hospitals use IT in health to improve the quality of their services. IT in the health sector such as electronic medical records (RME) has the potential to improve the quality of patient care by improving process efficiency, reducing errors and reducing costs [1]. Despite the many advantages, its application still encounters many problems. In Indonesia only 48% (1257 of 2588) hospitals that have a hospital management information system. In addition, the use of IT in the health field of medical personnel often gets a rejection [2]. Many believe that IT will provide benefits if received and used properly by users [3][4]. Stakeholder readiness and managerial decisions will bring better organizational performance, especially in the case of IT adoption [5].

It is important to know the definition of user acceptance from IT and what variables affect it. The exact definition of IT user acceptance will be the benchmark that illustrates IT's success. Therefore, research on acceptance theory of IT users is needed. Theory of Reasoned Action (TRA) and Theory of Planned Behavior (TPB) are models in the field of social

psychology that proved successful in explaining behavior. TRA explains that behavior is influenced by intentions that have multiple variables [6]. TPB has a behavior control variable that explains that the behaviors performed are also influenced by the existing situation [7]. In addition to TRA and TPB, the theory that explains user acceptance is the Technology Acceptance Model (TAM). In a study of comparisons of these three theories on the use of internet banking representing IT [8], it is evident that TAM is better at explaining the variance in overall model behavior and suitability.

In TAM, user acceptance is defined by the attitude in using a technology which then affects intention of use. And the factors that influence attitudes in using a technology are perceived usefulness (PU) and perceived ease of use (PEOU). PU is defined as the level of trust in a technology that using such technology will improve performance at work. PEOU is defined as the level of confidence, how easy the technology to use [9]. TAM is widely used in areas such as economics, education, industry, and health. While research TAM on IT in the field of health has been done and provide good results in predicting and explaining the acceptance of medical personnel to the use of IT in the field of health. This was stated by [10] who conducted reviews on more than 20 studies related to the theory of user acceptance of IT in the medical field including TAM, TAM added another variable or commonly called an expanded TAM and TAM's predecessor theories are TRA and TPB.

The expanded TAM in the field of health was developed in order to obtain a model suitable for the medical field. An example of research on TAM in the field of health that has been done is the research of [11] which adds variable quality information, service quality and system quality on the TAM model. Another extended TAM example is a study by [12] that add subjective variable norms, drawings, job relevance, output quality, demonstrable results, experience, and volunteerism. While in this study tested the expanded TAM model belonging to [13] because the model is systematic, intuitive and in accordance with case studies in this study that the use of IT is applied in compulsory rather than voluntary.

In Moores's models[13], TAM's expanded declared PU and PEOU a factor affecting user acceptance. PU and PEOU are also influenced by information quality and enabling factors. The quality of information is defined as the accuracy of

information and the absence of false information (accuracy), what kind of information is presented (content), information is presented in a format that is easy to read (format), and timeliness when the information is needed (timeliness). Enabling factors are defined to be the provision of assistance if there is difficulty in using technology (technical support), the ability of users in using the technology (self-efficacy). User acceptance is defined with attitudes in using technology and technological conformity by means of a user's preferred work (compatibility).

This study was also conducted to confirm research on TAM models by Moores[13]. The TAM model illustrates the factors related to IT user acceptance in the health field and how it relates. This study examines the relationship between variables on the Moores TAM model. The case study used is the acceptance of RME technology by medical personnel at one of the Hospital in East Java Indonesia.

This research uses a survey method with the questionnaire as a research instrument. The question on this research questionnaire is similar to that of Moores research but has been translated into Bahasa (Indonesia Language). The TAM model used is also the result of Moores research. Samples are medical personnel using RME at a Hospital. The number of samples was determined by using Slovin equation [14]. After the data obtained a multivariate analysis to test the model. Multivariate analysis technique used is Partial Least Squares (PLS) software. After the model is evaluated with PLS, model interpretation is done to find out the user acceptance picture on the research object. The goal of this study is to measure the suitability of Moores' expanded TAM model with the case study of RME acceptance by medical personnel at Indonesian Hospital.

II. METHODS

A. TAM Model

Moores proposed a TAM model applied to health care. The advantage of the Moores model is to use only the important variables that allegedly affect user acceptance. The Moores model retains PU and PEOU as the variable that determines the acceptance of IT users. The size that is considered as a form of acceptance is the use of the system (use), attitude to the system (attitude) and compatibility. The variables that affect PU and PEOU are information quality and enabling factor. Factors of experience using the system are also included in the model to know its relation to change of belief and satisfaction over time.

Each variable is explained by several indicators. Except for the variables of system usage, the indicators are a discourse that describes the feelings or circumstances felt by the users of the system. The indicators in this study are indicators used in Moores research and translated into Bahasa (Indonesian Language).

The model made this model based on Moores research. In Moores research, there is Behavioral Intention to Use (USE) variable but since the use of RME in this study is required by the Hospital, this variable is not included in the model. Moores states that if the use of the system is not an independent variable or in this case, its use is required, this variable has no longer logical validity, so the relationship between this variable

and other variables has no meaning. Moreover, in his hypothesis Moores gives an exception to the hypothesis regarding the use of the system, he states unless the system's use is required.

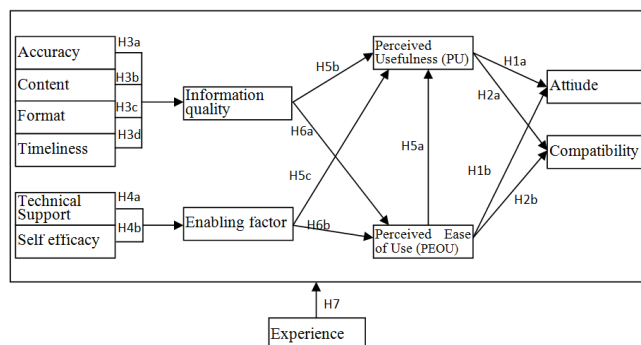


Fig. 1. Model to be tested

The hypotheses to be tested in this study include:

H1a. Attitudes will be affected significantly and positively by perceived usefulness;

H2b. Compatibility will be affected significantly and positively by perceived ease of use.

H3a. The quality of information will be affected significantly and positively by accuracy;

H3b. The quality of the information will be affected significantly and positively by the content

H3c. The quality of the information will be affected significantly and positively by the format;

H3d. The quality of the information will be affected significantly and positively by the timeliness

H4a. Possible factors will be affected significantly and positively by the technical support;

H4b. Possible factors will be significantly and positively influenced by self-efficacy;

H5a. Perceived usefulness will be affected significantly and positively by (a) perceived ease of use;

H5b. Perceived usefulness will be affected significantly and positively by the quality of information;

H5c. Perceived usefulness will be affected significantly and positively by possible factors;

H6a. Perceived ease of use will be significantly and positively influenced by the quality of information;

H6b. Perceived ease of use will be significantly and positively influenced by possible factors;

H7. Experience in using the system has a significant moderation effect on each IT acceptance component.

B. Questionnaire

In this study used a list of questionnaire statements on Moores research translated into Bahasa Indonesia. Respondents were asked to provide a score indicating the suitability of each

statement and what respondents felt using a Likert scale of 1 (disagree) to 7 (strongly agree). This study uses an odd scale with a value that is in the middle means neutral that is scale 4. Using a neutral scale means the data obtained is close to the perceived truth of the respondent. The seven-figure scale is more than any other scale that is often done in various studies such as three, four or five. The use of a seven scale in addition to aiming to equal Moores's research is easier than that so that the data obtained represent more of the diversity present in the population or the actual state.

TABLE I. QUESTIONNAIRE BASED ON VARIABLES

Variable	Indicator of the variable in the form of a statement
Accuracy	RME is accurate.
	I am satisfied with RME accuracy.
	Overall, I believe the information provided by RME.
Content	RME provides the information I need.
	The information content suits my needs.
	RME provides reports that I will use.
	RME provides sufficient information.
	Overall, the information content suited my needs.
Format	The Layout format of the screen makes it easy for me to read the information displayed.
	The information displayed is clear.
	Overall, I think the output is displayed in a useful format.
Timeliness	I get the information I need on time.
	RME provides up-to-date information.
	Overall, the information I needed was always available when I needed it.
	One particular person (or group) is available to help with hardware difficulties.
Technical Support	One particular person (or group) is available to help with system difficulty.
	Special directive instructions related to RME are available to me.
	Overall, I've been given sufficient support in the use of RME.
	I feel comfortable using RME myself.
Self-efficacy	I can easily operate my own RME.
	I can use RME, even when nobody shows how to use it.
	Overall, I am confident in my ability to use RME.
	Using RME on my work allows me to complete tasks faster.
PU	Using RME improves my work performance.
	Using RME allows me to increase productivity.
	Using RME improves the effectiveness of my work.
	Using RME makes my job easier.
	Overall, RME is useful for my work.
PEOU	Learn how to operate RME is easy for me.
	It's easy to make RME do something I want to do.
	My interaction with RME is clear and understandable.
	RME is flexible in interacting.
Attitude	It is easy for me to become an expert in using RME.
	Overall, RME is easy to use.
	In using RME I feel joy.
	In using RME I feel happy.
Compatibility	In using RME it is frustrating.
	In using RME I feel satisfied.
	Using RME fits perfectly with the way I work.
Compatibility	Using RME fits perfectly to my working style.
	Overall, using RME matches all aspects of my work

Questionnaires were given to respondents who were medical personnel using RME at a Hospital. The questionnaire was given along with cover letters and filling instructions. After two weeks, the questionnaire will be reassembled. Then

the results of the questionnaire data in the recapitulation in a spreadsheet program to further process with PLS program.

The study took place from November 3, 2014, to November 16, 2014. With the help of the head of Poli Department, research instruments in the form of paper questionnaires were given to medical personnel using RME. The questionnaire is accompanied by an explanation of the research objectives and instructions for using the filling. Respondents were given two weeks to fill and collect back to head Poli Department. The questionnaire used amounted to sixty-six to forty-seven doctors and nineteen nurses in Poli. A comparison of the number of doctors and nurses who were respondents is presented in Figure 2.

After two weeks after the questionnaire was distributed, the questionnaires were reassembled to obtain the necessary data for the study. Of the sixty-eight questionnaires distributed were obtained twenty-two reassembled questionnaires, fourteen questionnaires from doctors and eight questionnaires from nurses. Based on the percentage return of the questionnaire, more nurses returned the questionnaires than the doctors. Except for personal data, all the points in the questionnaire have been filled out. Because personal data is only filled with name data and do not fill data about the experience using the system. The H7 hypothesis that the influence of experiential variables on all variables on the model is not discussed in the study.

characteristics of respondents

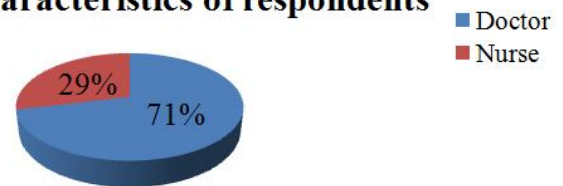


Fig. 2. characteristics of respondents

III. RESULTS AND DISCUSSION

A. Evaluation of Measurement Models

The model was tested by using two kinds of evaluation ie evaluation of measurement model and evaluation of the structural model. Both are done by first doing the calculation of PLS algorithm with the help of PLS program. Evaluation of the first measurement model is to evaluate the loading factor value. In the calculation result of PLS algorithm of load factor value from accuracy_3 indicator correlated with accuracy variable, k_akurasi_3 indicator correlated with the variable of information quality and indicator attitude_3 correlated with attitude variable less than 0,6 which is criterion from acceptable loading factor value.

Since the loading factor value of the accuracy_3 indicator correlated with the accuracy variable is 0.4433 means that the information provided by RME is free from error is not an indicator of the accuracy variable. Since the loading factor value of the k_akurasi_3 indicator correlated with the variable of quality of information is 0.2958. it means that the information provided by RME is free from error is not an indicator of the variable quality of information. Since the

loading factor value of the attitude_3 indicator that correlates with the attitude variable is 0.2572 means that the statement that using RME is frustrating is not an indicator of the variable of information quality.

The next step, the accuracy_3 indicator, k_akurasi_3 indicator, and the attitude_3 indicator are removed from the model and then recalculated. When compared, it will be seen that the loading factor value of each indicator after the recalculation becomes increased.

TABLE II. EVALUATION RESULT OF COMPOSITE RELIABILITY AND AVE

Variable	AVE	Composite Reliability
PEOU	0,7126	0,9367
PU	0,7283	0,9412
Accuracy	0,8509	0,9195
Technical Support	0,7014	0,9033
Enabling factor	0,6241	0,9292
Self-efficacy	0,8017	0,9416
Compatibility	0,9169	0,9707
Timeliness	0,8062	0,9258
Content	0,7152	0,9258
Information quality	0,609	0,9526
Attitude	0,8668	0,9513

The evaluation of the next measurement model is the evaluation of composite reliability and AVE evaluation. The composite reliability value received is more than 0.7 and the AVE value received is above 0.5. The evaluation results of composite reliability and AVE are presented in Table 2.

Based on table 2, no variables were found that did not meet the criteria. Each variable has a value of composite reliability above 0.7 which means any reliable variable. Each variable has an AVE value above 0.5 which means that every indicator variable and variable proves valid.

B. Evaluation of Structural Model

The structural model evaluation consists of two stages: evaluating the value of standardized path coefficients and evaluating the GoF value. The value of standardized path coefficients between variables is presented in Table 3.

TABLE III. PATH BETWEEN VARIABLE COEFFICIENT VALUE

Variable	Path Between Variable Coefficient Value
PEOU -> PU	0,6785
PEOU -> Compatibility	0,5023
PEOU -> attitude	0,3308
PU -> Compatibility	0,3366
PU -> attitude	0,5039
Accuracy -> Information quality	0,2022
Technical Support-> Enabling factor	0,4786
Enabling factor-> PEOU	0,8559
Enabling factor-> PU	-0,4221
format -> Information quality	0,2614
Self-efficacy -> Enabling factor	0,6165
timeliness -> Information quality	0,2438
Content -> Information quality	0,4204
Information quality-> PEOU	-0,0172
Information quality-> PU	0,6308

Based on table 3 there are two paths that have a standardized path does not meet the criteria. The value of standardized path results from the enabling factor to PU and information quality to PEOU is less than 2.0. The two paths that do not meet these criteria, it is mean that the two paths have weak interdependent relationships. To calculate the GoF value required *communality* and R^2 generated by PLS program, the value is presented in Table 4.

TABLE IV. COMMUNALITY AND R²

Variabel	Communality	R ²
PEOU	0,7126	0,7114
PU	0,7283	0,5607
Accuracy	0,8509	0
Technical Support	0,7014	0
Enabling factor	0,6241	0,9997
Format	0,811	0
Self-efficacy	0,8017	0
Compatibility	0,9169	0,6074
Timeliness	0,8062	0
Content	0,7152	0
Information quality	0,609	0,9998
Attitude	0,8668	0,5997
Means	0,7620	0,3732

By the formula (1) can be calculated the value of GoF namely:

$$GoF = \sqrt{Communality \times R^2}$$

$$GoF = \sqrt{0,762008333 \times 0,373225}$$

$$GoF = 0,5332$$

Because GoF values meet criteria (greater than 0.36), it means the model in this study can be called overall a good model.

TABLE V. SIGNIFICANCE OF HYPOTHESIS

Hypothesis	Path between variables	t value	Hypothesis test results
H1(a)	PU -> attitude	3,9636	accepted
H1(b)	PEOU -> attitude	2,2593	Accepted
H2(a)	PU -> Compatibility	4,6836	accepted
H2(b)	PEOU -> Compatibility	5,8789	accepted
H3(a)	Accuracy -> Information quality	15,1705	accepted
H3(b)	Content -> Information quality	26,6447	accepted
H3(c)	format -> Information quality	12,7567	accepted
H3(d)	timeliness -> Information quality	24,0762	accepted
H4(a)	Technical Support-> Enabling factor	24,1617	accepted
H4(b)	Self-efficacy -> Enabling factor	19,5425	accepted
H5(a)	PEOU -> PU	4,3342	accepted
H5(b)	Information quality-> PU	5,3563	accepted
H5(c)	Enabling factor-> PU	1,9807	accepted
H6(a)	Information quality-> PEOU	0,1798	rejected
H6(b)	Enabling factor-> PEOU	13,0459	accepted

C. Hypothesis Testing

A hypothesis test is done by comparing the value of t arithmetic to the value of t table. A hypothesis described in a path is considered significant if it has a value of t arithmetic greater than the value of t table. With a real level of 5% obtained t table value of 1.96. While the value of t arithmetic obtained from the calculation of bootstrapping with 500 samples. The result of comparison of t value arithmetic with t table used as hypothesis significance test can be seen in table 5. Based on the comparison between the value of t arithmetic with t table there are fourteen hypotheses accepted and one hypothesis rejected. Graphical representation can be seen in figure 3.

D. Discussion and limitations

What is worth noting is that this study only studies the phenomenon of electronic medical records by doctors and nurses in a single hospital. Some limitations that arise are the quality of medical record application and its application in hospitals is also a dominant factor affecting the results of this study. Besides that, we cannot measure the experience factor in the study because the respondents choose to empty experience field for some reason.

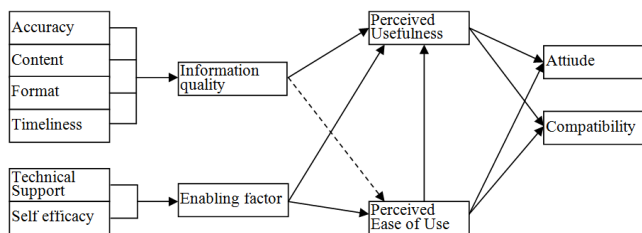


Fig. 3. Result of PLS analysis. Note: Significant paths shown in bold.

Of the sixteen hypotheses proposed there are fourteen accepted hypotheses, one untested hypothesis, and one rejected hypothesis. The untested hypothesis is that experience in using the system has a significant moderating effect on each component of information technology acceptance (H7). The rejected hypothesis is that perceived ease of use will be significantly and positively influenced by the quality of information (H6a).

The results obtained have similarities with the results of the previous Moore studies [13], especially for the level of IT acceptance for healthcare with low experience. Information quality equally has no significant effect on Perceived Ease of Use. In Moore model, the user with high experience, Information quality has a significant influence on Perceived Ease of Use.

IV. CONCLUSIONS

We measure the level of IT adoption, especially medical records in a hospital using TAM model. The results obtained are the characteristics and factors of application of medical record according to TAM in revealed. The results of the study state that the factors that influence the acceptance of IT, especially the use of hospital medical records are Content, Timeliness, Technical Support, Self-efficacy, and Accuracy.

The only unacceptable hypothesis is Information Quality to Perceived Ease of Use. However, information quality remains significant for Perceived Ease of Use. For further research can confirm the results by taking a larger sample size and covering hospitals that are throughout Indonesia so that the model tested can describe the conditions that occur in Indonesia.

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